SEQUOIA AND KINGS CANYON NATIONAL PARKS WILDERNESS CHARACTER ASSESSMENT:

An examination of the characteristics and conditions of designated and proposed wilderness in Sequoia and Kings Canyon National Parks

June, 2014

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Cover photo: Looking southeast from Bighorn Plateau, Sequoia National Park.
Credit: (NPS/E. Frenzel)

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INTRODUCTION AND PURPOSE

A wilderness character assessment describes the extent to which an area is natural; untrammeled; undeveloped; has opportunities for solitude or primitive recreation and unconfined recreation; and may have other features of value in or to a wilderness.

Wilderness Legislation and Wilderness Character

The Wilderness Act of 1964 (Act) established the National Wilderness Preservation System as a framework for protecting wild federal lands (Wilderness Act of 1964). The intent was to preserve wild areas and protect them from the impacts of increasing population growth and modification of the landscape while allowing current and future generations to experience them in an unaltered, natural, and primitive state.

The Act established a National Wilderness Preservation System where lands so designated by Congress would constitute wilderness areas that:

> "shall be administered *for the use and enjoyment of the American people* in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, [and] *the preservation of their wilderness character*" (emphasis added).

The Act also defined wilderness by describing its qualities:

> "A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."

[Note: The use of the word *untrammeled* in the Act was intentional. Though often confused with the word *untrampled*, *untrammeled* aspires to the lack of actions taken by humans to control or manipulate land, its use, or condition, e.g. spraying of pesticides, suppressing fires, collaring wildlife. *Untrammeled* was chosen by the authors of the Wilderness Act to describe the uncontrolled nature of wild lands.]

While the Wilderness Act identified the common qualities that define wilderness character, each wilderness area has its own special traits. For example, the attributes that contribute to "opportunities for solitude" in the Otis Pike Fire Island High Dune Wilderness on Long Island in New York may not be the same as the attributes that provide those opportunities in the Gates of the Arctic Wilderness in the Alaskan interior. The distinctiveness of each wilderness "means that change in wilderness character can only be understood *in the context of a particular area…relative to the time the area was designated* as wilderness" (emphasis added) (Landres, et. al. 2008).

History of Wilderness Character Preservation at Sequoia and Kings Canyon National Parks

Preservation of wilderness character in Sequoia and Kings Canyon National Parks (hereafter parks) predates the passage of the Wilderness Act. Sequoia and General Grant (the small forerunner of Kings Canyon) national

parks were initially established in 1890 (Sequoia National Park and Forest Reserve Act). While the park idea was still new, some values which would later be codified in the Wilderness Act were present in the enabling legislation. The language specified that national parks were set "apart as a public park, or pleasure ground, for the benefit and enjoyment of the people" and should be managed to preserve them "in their natural condition" (Sequoia National Park). A quarter-century later, Congress provided further direction for managing parks through the National Park Service Organic Act of 1916, which established the National Park Service (hereafter "NPS" or "park service") and directed that they "promote and regulate" lands in their care in order to "conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (Organic Act of 1916). The mandate to preserve the natural, cultural, and scenic value of public lands while providing opportunities for their enjoyment is a theme that runs throughout the Wilderness Act as well.

When Congress enlarged General Grant National Park into the renamed Kings Canyon National Park on March 4, 1940, the legislation included a provision that "…the Secretary of the Interior may, in his discretion, limit the character and number of privileges that he may grant within the Kings Canyon National Park in order to *insure the permanent preservation of the wilderness character*" (emphasis added) (Kings Canyon National Park). This enabling legislation may mark the first time that a land management agency was directed specifically to preserve "wilderness character," with similar language later included in the Wilderness Act of 1964.

…to know the wilderness is to know a profound humility, to recognize one's littleness, to sense dependence and interdependence, indebtedness, and responsibility.

~ Howard Zahniser
(primary author of The Wilderness Act), 1956

Guitar Lake
(NPS Photo)

The first formal additions of Sequoia and Kings Canyon National Parks' land to the National Wilderness Preservation System (NWPS) came following studies of wilderness suitability, which culminated in the early 1970s. These studies identified three large undeveloped tracts of land that were suitable for formal wilderness designation. The largest was the Sierra Crest area, consisting of most of Kings Canyon National Park and much of Sequoia National Park east of its developed areas. The second was the Hockett Plateau area of Sequoia National Park. The third was the lands of the North Fork of the Kaweah River in Sequoia National Park and parts of the Redwood Canyon area of Kings Canyon National Park. All three of these areas, with some limited exceptions, were found to be suitable for wilderness designation.

In 1984, Congress passed the California Wilderness Act establishing the 723,036-acre Sequoia-Kings Canyon Wilderness, which designated the Sierra Crest section of land described above (California Wilderness Act). The

act did not include the other two sections, but did so "without prejudice," thereby allowing future reconsideration for wilderness designation. Under NPS policy, management of these lands continued in a manner that would not degrade their suitability for future consideration as wilderness. In 2009, Congress designated the 39,740-acre John Krebs Wilderness, which consists of most of the northern portion of the Hockett Plateau and Mineral King areas (Omnibus Public Land Management Act). This act also added 45,186 acres to the Sequoia-Kings Canyon Wilderness by designating the North Fork Kaweah and Redwood Canyon areas as wilderness. The legislation directed that the remaining lands that were eligible but undesignated, primarily 30,000 acres of the southern end of the Hockett Plateau, be managed as wilderness by the NPS (Omnibus Public Land Management Act).

Final boundaries were determined and mapped using GIS-based mapping tools (Figure 1): the 1984 Sequoia-Kings Canyon Wilderness consists of 722,983 acres; the 2009 addition to the Sequoia-Kings Canyon Wilderness consists of 45,129 acres; and the John Krebs Wilderness designated in 2009 consists of 39,967 acres. Together, these designated wilderness areas total 808,078 acres (93.3%), of Sequoia and Kings Canyon National Parks. An additional 29,516 acres (3.4% of the parks) remains classified as proposed wilderness and is managed in the same manner as designated wilderness per NPS policy. This brings the total of park lands managed as wilderness to 837,594 acres, or 96.7% of these parks.

Included in parks' wilderness designation actions are an additional 212 acres of Designated Potential Wilderness Additions (DPWA). DPWAs are areas where wilderness is affected by non-conforming uses, such as dams in Mineral King, the Bearpaw Meadow High Sierra Camp, and power-transmission lines. These special uses are allowed by Congress, either through legislative language in the act(s) designating wilderness, or in legislative reports supporting the act(s). DWPAs are managed as designated wilderness except that the non-conforming use is allowed. By virtue of DPWA status, if and when these uses stop, the NPS is authorized by Congress and directed by policy to take administrative action to finalize designation of these areas as wilderness.

Purpose of the Wilderness Character Assessment

While the Wilderness Act of 1964 mandated that federal agencies preserve wilderness character, only recently has a national framework been developed for assessing and monitoring changes in wilderness character on the ground (Landres et. al. 2008, and Landres et. al. 2005). As part of this framework, the NPS Wilderness Character Integration Team has recommended that parks develop basic information about the wilderness they administer, including legislative history and boundaries, a wilderness character assessment, and separate narrative, and issues that should be addressed in future wilderness stewardship planning (National Park Service 2014). This basic information informs baseline assessment and continued monitoring of wilderness character.

Within this context, the role of a wilderness character assessment is to describe "what is unique and special about a wilderness" and provide a "positive and affirming description of the current state of a wilderness area." The assessment and narrative are also an opportunity to identify important additional scenic, cultural, educational, or other features that contribute significantly to wilderness character (National Park Service 2014).

In addition to describing the special characteristics of the parks wilderness, this assessment also identifies actions or conditions that are degrading or improving its wilderness character. While not intended as an exhaustive catalog of all possible impacts, it identifies major issues and potential trends in wilderness character with emphasis on issues that may be addressed though future stewardship planning and management. This assessment also intimates which measures of wilderness character may be most valuable in monitoring changes in wilderness character through time. These measures will be further developed in other management documents such as the Wilderness Character Map, Wilderness Stewardship Plan, and the Resource Stewardship Strategy.

The following assessment first describes the methods used to gather wilderness-character information. It describes each of the five qualities of wilderness character, what contributes to each quality within the park wilderness, what actions and conditions might degrade each quality, and what potential trends may exist for each quality.

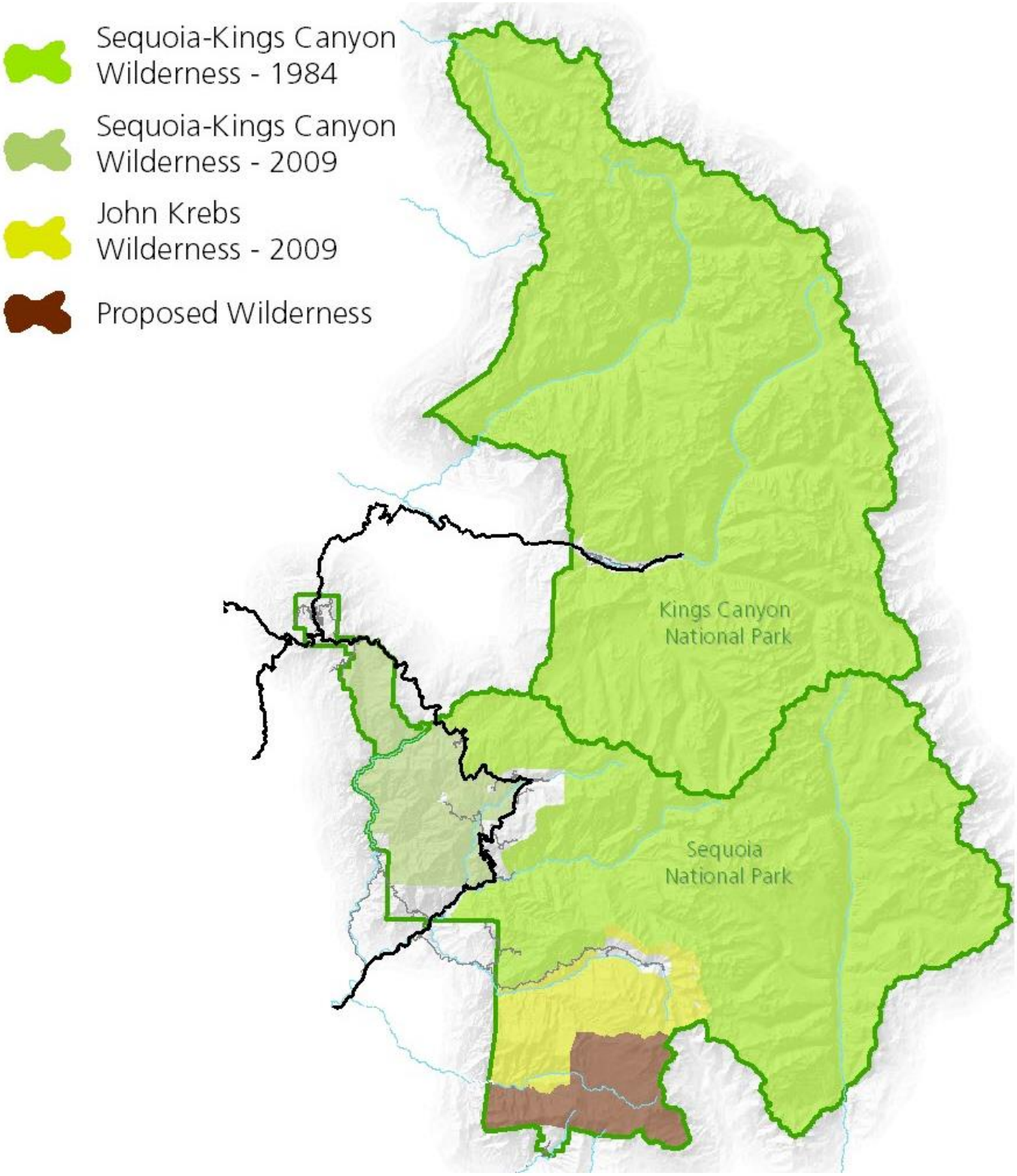

Figure 1. Wilderness designations in Sequoia and Kings Canyon National Parks.

METHODS

Information for this assessment came from surveys, interviews, and a workshop with current and former park employees who have extensive experience in and with the parks' wilderness. It also incorporates public comments from scoping sessions for two relatively recent wilderness planning efforts.

Wilderness Ranger Survey

Background on wilderness character and its elements was presented to ten of the park's seasonal wilderness rangers in June, 2010. These rangers have extensive knowledge of the history of wilderness conditions and management, with many of them measuring their experience in the parks in decades. The survey asked them to rank the current and projected future (five to ten years) condition of four qualities of wilderness character within the parks. Ratings are on a 1-to-10 scale, with 10 being the most desirable condition of the quality and 1 representing the minimum condition to meet eligibility for wilderness. They were also encouraged to record reasons for their rankings. Brief instructions were given to the participants, but their comments indicate that these may not have adequately distinguished the definitions of wilderness qualities (particularly the difference between *untrammeled* and *undeveloped*).

If we are to have broad-thinking men and women of high mentality, of good physique and with a true perspective on life, we must allow our populace a communion with nature in areas of more or less wilderness condition.

~ Arthur Carhart,
writer and conservationist

Mount Whitney from the west
(NPS Photo)

Wilderness Character Workshop and Interviews

On November 18, 2010, wilderness managers conducted a workshop with current and former park employees in order to collect information about wilderness character in these parks. Participants reviewed background material before the workshop and received an introduction to the wilderness character qualities and how management and other actions enhance or negatively impact each quality. The group included eight people representing science, interpretation, visitor and resource protection, and administration disciplines. Their experience with the parks' wilderness ranged from 2 to 36 years, with a total of over 170 years of local wilderness experience represented.

The goal of the workshop was to identify actions and conditions that either contribute to or detract from the parks' wilderness character. Participants also identified how they perceive trends in the four qualities of wilderness character, and developed consensus ratings for each quality on a 10-point scale (10 being the most desirable condition and 1 representing the minimum condition to meet eligibility for wilderness). They also discussed and ranked potential measures for a wilderness-character monitoring program.

The workshop coincided with a series of interviews with eight park employees from varied disciplines: natural and cultural resources, maintenance, and visitor protection. Interviewees had between 16 and 41 years of experience in the parks' wilderness, with a combined experience of over 190 years. Goals for interviews, which took place from November 16-23, 2010, were the same as for the workshop, with additional emphasis placed on capturing personal descriptions and viewpoints regarding wilderness character.

Public Comments

Public responses from two wilderness planning efforts were also used to identify what contributes to and detracts from wilderness character in the parks. The first set of 390 responses was from an initial public scoping conducted in 1998 to develop a Wilderness Management Plan (Fauth and Tarpinian, 2011). The second set, nearly 900 responses, was submitted by the general public, government agencies, and interest groups during initial public scoping for a Wilderness Stewardship Plan from April 11 to August 31, 2011 (National Park Service 2011k).

Synthesis

Responses were grouped according to the four primary qualities of wilderness character described in the "Keeping It Wild" interagency wilderness character framework (Landres et. al. 2008). Additional ecological, geological, scientific, educational, scenic, or historical values described by respondents were identified. Common themes and issues that affected multiple qualities were identified. Information from inventory and monitoring programs, visitor-use data, and relevant studies were added to provide context.

By wilderness I mean a continuous stretch of country preserved in its natural state, . . . big enough to absorb a two-week pack trip . . .

~ Aldo Leopold, 1921

Upper Basin
(Photo courtesy of Isaac Chellman)

WILDERNESS CHARACTER QUALITY ASSESSMENT

While wilderness has different meanings to different people, this assessment of wilderness character in the parks is based on the qualities described within the Wilderness Act. It follows the framework and terminology of the "Keeping it Wild" interagency wilderness character monitoring strategy, which is a guiding document for NPS Wilderness Character Integration efforts (Landres, et. al. 2008, and National Park Service 2014). As such, it considers the following qualities:

1. *Natural*
2. *Untrammeled*
3. *Undeveloped*
4. *Opportunities for solitude or primitive and unconfined recreation*
5. *Other features of value* (ecological, geological, recreational, scenic, scientific, educational, conservation, historical)

For each of these five qualities of wilderness character, this assessment describes the distinctive aspects and features that contribute to the quality, identifies significant actions or conditions that degrade the quality, and then summarizes what is known about the current state and possible trends in the condition.

NATURAL

The Wilderness Act states that wilderness is "protected and managed so as to preserve its natural conditions." Wilderness is most natural when "the indigenous species composition, structures, and functions of the ecological systems in wilderness are protected and allowed to be on their own, without the planned intervention or the unintended effects of modern civilization" (Landres et. al. 2008). The *natural* quality is related, but distinct from the *untrammeled* quality; the latter refers to **actions** taken by humans to control or manipulate land, its use, or condition, while *natural* applies to the **effects** of humans on the land. The condition of the natural quality is determined by the effects of modern civilization or human intervention on ecological systems and their biological and physical components.

Attributes of the *natural* quality

The wilderness in Sequoia and Kings Canyon National Parks comprises distinctive and varied natural landforms. It includes rugged 14,000-foot peaks and steep canyons rivaling the Grand Canyon in depth. The headwaters of four major river systems (South Fork San Joaquin, Kings, Kaweah, and Kern) are protected within the wilderness. The Kern River is the only major river in the Sierra Nevada that runs parallel to the axis of the mountain range; the rain shadow caused by the Great Western Divide results in a distinctive, dry environment in the Kern River drainage in which unique species assemblages occur. Cave and karst formations are another outstanding physical feature of the parks' wilderness. The parks contain more than 275 known caves, and many of the parks' cave resources lie within designated or proposed wilderness. The parks' wilderness contains the longest cave in California (Lilburn), uncommon high-elevation caves (White Chief), and caves with outstanding and pristine mineral formations (National Park Service 2011a).

The subalpine and alpine areas are also distinctive natural elements of the park's wilderness. Relative to the rest of the central and southern Sierra Nevada, the parks contain a disproportionately large portion of high-elevation habitats; over 50% of the parks' area is above 9,800 feet, while only 11% of the entire region is above that elevation (Thorne et. al. 2013). These high-elevation lands are a valuable conservation resource. The high elevations of the parks' wilderness areas are less impacted by polluted air (Panek et. al. 2013), are less invaded by nonnative species (Tu et. al. 2013, and Blickley et. al. 2013), and have had less severe departures from historical fire regimes (as they have experienced less fire suppression than the region's lower elevations and have much lower fire frequencies) (Thorne et. al. 2013 and National Park Service 2011c).

Lying at the southern end of the great Cascade-Sierra cordillera, the parks support not only species found at the southern end of their ranges, but also species from adjacent desert and great basin biogeographic provinces plus a host of local endemics. The combination of location, large size, and diversity of habitats contributes to great numbers of species being found in the parks. Native taxa include 1365 plants, 9 amphibians, 23 reptiles, 5 fishes, 84 mammals, and 212 birds (Schwartz et. al. 2013). Of the vertebrate and plant taxa present in California, 15% have been observed in the parks, although the parks occupy less than 1% of the state's land area (Schwartz et. al. 2013). In addition to overall diversity, the parks' wilderness is also notable in the number of local and regional endemic species it protects. This is especially pronounced in caves, where 35 invertebrate species have been found that exist only within single cave systems or watersheds within the parks (National Park Service 2011a). The parks are also home to 11 taxa of plants that occur only within 5 miles of the park boundary, as well as 39 taxa considered endemic to the southern Sierra Nevada (Huber et. al. 2013).

The regional endemics include two very visible and characteristic tree species--giant sequoias and foxtail pines. Some 65% of the area of sequoia groves in the parks lie within designated wilderness, as does roughly 20% of the area of all sequoia groves in the world (National Park Service 2011f, and Harvey et. al. 1980). The subspecies of foxtail pine found in the parks occurs only in the Sierra Nevada; it grows no further north than the middle fork of the Kings River in Kings Canyon National Park and reaches its southern limit just south of the Sequoia National Park boundary (Little 1971). These two globally significant tree taxa form distinctive forests in the parks' wilderness. Subalpine woodlands of whitebark pine in the parks' wilderness (Figure 2) are notable as well, as they have been less affected by the blister rust and beetle outbreaks that have decimated populations in the Rocky Mountains (Eschtruth et. al. 2013).

Figure 2. Krummholz stands of whitebark pine near Kearsarge Pass. *(NPS Photo by C. Cann)*

In addition, terrestrial food webs are largely intact within the parks' wilderness. For example, all but two of the historically present vertebrate predators (grizzly bear and wolverine) still exist in the parks (Blickley et. al. 2013).

A particularly valuable aspect of the parks' natural quality is the presence of large biophysical gradients. Tracts of wilderness crossed only by footpaths stretch from foothills and canyons starting at 1,400 feet in elevation to Mount Whitney, the tallest peak in the contiguous United States at 14,494 feet. This represents the greatest elevation range of any protected area in the lower 48 states (Tweed 1997). Only one road completely divides the westernmost wilderness segment from the remainder, only two seasonally used roads penetrate the deeper canyons of the western slope, and no road crosses the crest of the Sierra Nevada to interrupt the long north-south axis of the wilderness. The large size and continuity of this wilderness protects important wildlife corridors and migration routes between high-elevation protected areas of the southern Sierra and relatively undeveloped areas to the east of the parks, as well as a major corridor along the Sierra Crest connecting the Tehachapi Mountains and the central Sierra Nevada (Thorne et. al. 2013).

Due to this low level of fragmentation, and because the park's wilderness abuts wilderness on the Inyo, Sierra, and Sequoia national forests, the park wilderness is at the heart of a contiguous area of wild lands that provide the highest level of natural-resource protection for roughly 25% of the Southern Sierra Nevada (Thorne et. al.

2013). This large size and great diversity of habitats is likely to be important over time as species ranges shift in response to climate change. The vast area can also provide habitat for species with large home ranges that may be impacted by California's increasing population and the resulting fragmentation of undeveloped lands.

Threats to the *natural quality*

Unfortunately, the large size of the park's wilderness is no protection against a number of threats to its *natural* quality. Many of the agents that impact natural conditions in the wilderness originate primarily outside the parks and are difficult or impossible to influence, resist, or mitigate.

Sequoia and Kings Canyon National Parks periodically experience the worst air quality in the National Park Service. Elevated ground-level ozone may be the most damaging pollutant in the parks; concentrations often exceed the federal ozone health standards in summer months. The effects go beyond human health and into park ecosystems, including widespread damage to sensitive vegetation, which can alter how plants grow, produce, and store energy. In addition to ozone pollution, deposition of nutrients and contaminants (such as such as nitrogen, sulfur, heavy metals, herbicides, and pesticides) from various local and global sources concentrate along the west side of Sequoia National Park (Panek et. al. 2013) (Figure 3). In a study of western national parks, these parks ranked highest in contamination of air, vegetation, snow, and water by semi-volatile organic compounds. Some fish found in the Kaweah River drainage contained high enough levels of dieldrin, DDT, and mercury to pose health risks to humans and other predators (Landers et. al. 2008). Nutrient enrichment of aquatic and terrestrial systems in the parks' wilderness also threatens the natural quality (Panek et. al. 2013, Sickman et. al. 2003, and Sickman and Bennett 2011).

Figure 3. Air pollution in the San Joaquin Valley (gray band on the far horizon) visible from the summit of Mt. Whitney. *(NPS Photo by R. Pilewski).*

Human-caused changes in fire regimes have also decreased the *natural* quality of the parks wilderness, although these changes were more severe in the decades prior to wilderness designation. A century of fire suppression in the mid-elevations of the parks has resulted in unnaturally high fuel loads, which increases the risk of catastrophic fire. In addition, periodic fire is important to the life-cycle of giant sequoia and other organisms. As a result of fire suppression, nearly 79,000 acres of fire-dependent ecosystems in the parks' wilderness have missed multiple natural fire-return cycles, and sequoia reproduction has decreased (Parsons and DeBenedetti 1979, and National Park Service 2011c).

The influences of contemporary human presence in wilderness can also cause negative impacts to the *natural* quality. Human and stock traffic on trails mobilizes soil that may erode at an increased rate (Deluca et. al. 1998). Feet and hooves trample native vegetation (Cole and Spildie 1998), and can introduce nonnative plants (Quinn et. al. 2010). The impacts of human and stock traffic can also have subtle but measurable impacts on community structure and function (Holmquist and Schmidt-Gengenbach 2008, and Holmquist et. al. 2014). Grazing by sheep and cattle (historically) and pack and saddle stock (ongoing) decreases the natural quality of the parks' meadows and associated vegetation, which lacked large or numerous native grazers prior to arrival of

Europeans. Over the last 25 years, pack and saddle stock grazing in the parks has averaged more than 8,000 stock nights/year (Frenzel and Haultain 2011). Though water quality throughout the wilderness remains very good, human and stock waste may periodically elevate pathogen and nutrient concentrations in waterways and soils (Clow et. al. 2013). Wild animals may become food conditioned as a result of human presence, which detracts from their wild quality. For example, bears, marmots, coyotes, deer, ravens, and gray-crowned rosy finches may obtain food from visitors at recreational destinations (Figure 4). Sounds and artificial light introduced by wilderness visitors can also alter some animal behaviors and may affect reproductive and survival capacity.

Figure 4. Gray-crowned rosy finch.
(NPS Photo by I. Chellman).

The parks retain most of their native vertebrate fauna, although the California grizzly bear and foothill yellow-legged frog have been locally extirpated. Currently, neither the wolverine nor the California condor is considered likely to be present in the parks (Blickley et. al. 2013), though there have been verified condor sightings very near the parks in 2014 (Gammons 2014). Six extant vertebrate species are listed or are candidates for federally threatened or endangered status (Sierra Nevada bighorn sheep, two species of mountain yellow-legged frogs, Yosemite toad, Pacific fisher, and the Little Kern golden trout), while several others are believed to be at risk (Blickley et. al. 2013 and Schwartz et. al. 2013). Only one plant (whitebark pine) found in the parks' wilderness is a candidate for listing under the federal Endangered Species Act. There are myriad other animal and plant species in the parks that are considered at-risk or vulnerable (Huber et. al. 2013).

Climate change also threatens the natural quality of wilderness. Climate change related impacts already observed in the Sierra Nevada include rising temperatures (Edwards and Redmond 2011, and Das and Stephenson 2013), earlier snowmelt and changes in stream runoff patterns (Andrews 2012), shrinking glaciers (Basagic and Fountain 2011), changes in distributions of small mammals (Moritz et. al. 2008), and increasing mortality rates of trees related to a temperature driven increase in drought (van Mantgem and Stephenson 2007).

Status and trends of the *natural* quality

Workshop participants mostly rated the *natural* quality near the middle of the spectrum with a couple participants varying toward the lower end of the spectrum: scores ranged from 25-50%. Wilderness rangers perceived the parks as natural, with a mean score of 70%, while biologists were more likely to perceive the parks as negatively impacted in the *natural* quality. Of the primary wilderness character qualities, *natural* diverged most in opinions expressed about its current and future status.

There have been notable improvements in some factors that increased the natural quality over the past several decades (and since designation in 1984), many of which have been a consequence of NPS intervention.

- Changes in policy to allow some ignitions to burn, as well as a program of prescribed fire, has improved the natural quality in some parts of the wilderness.

- Some nonnative plant populations have been greatly reduced or extirpated in the parks' wilderness as the result of focused programs (Bahm 2013).

- Restoration programs have removed nonnative fish from 19 lakes, including complete eradication from eight lakes and near eradication from five lakes. This has led to increases in populations of frogs and other native animals such as gray-crowned rosy finches and garter snakes (Boiano and Meyer 2011).

- The on-going impacts of cattle grazing were removed when the last of the historic grazing permits expired by the 1980s (Neuman 1990), although there is still occasional cattle trespass in wilderness, primarily in the western foothills.

- Total pack and saddle stock grazing in the last three decades has decreased to less than half or of the previous three decades. The proportion of supplemental feed used in lieu of grazing has been increasing since 1997 (Frenzel and Haultain 2011), further lessening grazing impacts.

- Restoration actions have reduced the number and size of thousands of campsites (Cole and Parsons 2013), routed trails away from sensitive habitats, and restored meadows to a more natural state.

- Education of visitors and improvement in food-storage methods has led to a decrease in human-bear conflicts in the wilderness (these averaged over 100 incidents/year from 1980 to 1990, but fewer than 20 incidents/year from 2000-2010 [Mazur and Gammons 2011]), resulting in a more natural and wild bear population.

- Bighorn sheep populations in the parks appear to be thriving and are expanding following their near extirpation in the mid-20th century. This has resulted from preventing contact with domestic sheep and goats as well as reintroduction actions (National Park Service 2011b). In early 2014, a group of Bighorn sheep was introduced to a previously vacant historic herd unit in the Big Arroyo area of Sequoia National Park (Gammons 2014).

Some of the most challenging stressors are those outside of direct NPS control--such as air pollution and climate change.

Climate change may be one of the most challenging stressors that threaten the natural quality of wilderness, with uncertain and variable outcomes. There is also uncertainty about the long-term effects on the *natural* quality from other outside anthropogenic conditions, including light and noise pollution, that appear to be worsening or stable, respectively.

There are substantial uncertainties about the future trend of natural-resource conditions in general. Due to a rapidly changing global climate, fire managers may find it infeasible to return wilderness to a natural fire regime. Even if air-quality or drought concerns did not compel the parks to suppress fires or limit prescribed burning, the current extent and frequency of fires is far below historical levels (Caprio and Graber 2000). The impact of nonnative pathogens currently in the parks— and others yet to arrive (such as sudden oak death, and bat white nose syndrome)—could have synergistic effects with other stressors that result in profound impacts on park flora and fauna. Introduction of nonnative invertebrates present in nearby waters (such as the New Zealand mudsnail, zebra mussel, and quagga mussel)—could severely disrupt aquatic ecosystems already degraded by nonnative fish and airborne contaminants (Blickley et. al. 2013).

The participants in the wilderness workshop and interviews included several natural resource specialists, some of whom perceive the *natural* quality to be declining, with low elevation nonnative plant invasions, and deviation from historic fire return intervals being the primary impacts. One sentiment expressed was, “the closer we look the more problems we see.” This may explain how evaluations of the *natural* quality differed between rangers, the public, and resource specialists (Graber 2003). Others in the workshop, including long-tenured scientists, held a less pessimistic viewpoint but still expressed concerns. This raises the question of whether the grandiose outward appearance of the parks’ landscapes can mask gradual or small—but important—changes in the ecological processes. Regardless, a key challenge in preserving the *natural* quality of the park’s wilderness will be to determine what is possible, desirable, and feasible in maintaining ecosystems and biodiversity in the face of a changing climate (Hobbs et. al. 2010).

Since designation, the overall condition of the *natural* quality in these parks’ wilderness has likely improved. On-the-ground management practices and actions have moved this quality in a positive direction, notably: the cessation of fire suppression when air quality, weather, and fuel conditions permit; the restoration of high

altitude aquatic systems; the removal and rehabilitation of campsite impacts; the improved behavior of wilderness users as the result of education (e.g., *Leave No Trace*); and improved controls on wilderness use, including campfire restrictions and recreational grazing management. However, large-scale perturbations, such as continued air pollution and contaminant deposition, climate change, and the potential for invasion by nonnative species continue to pose significant threats that will be difficult to mitigate (Figure 5).

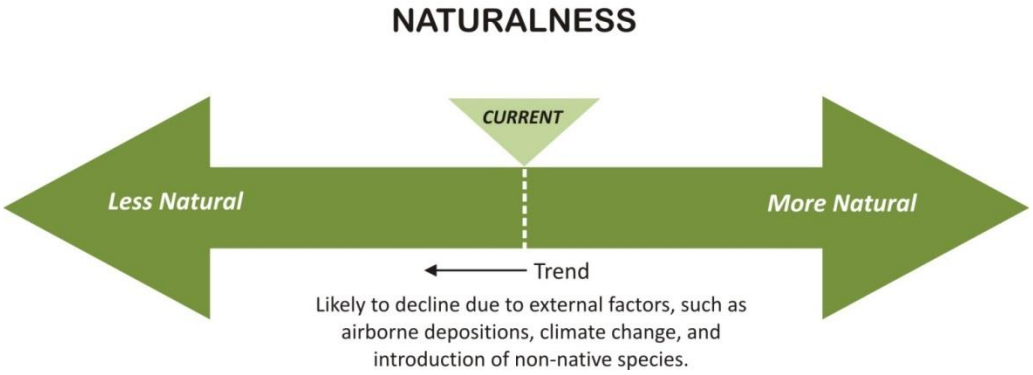

Figure 5. Graphic depicts estimate of current status and anticipated trend on the natural quality of wilderness character.

UNTRAMMELED

The Wilderness Act states that wilderness is "an area where the earth and its community of life are untrammeled by man" and that "generally appears to have been affected primarily by the forces of nature." The uncommon but intentionally chosen word "untrammeled," often mistaken for "untrampled," describes something that is unconstrained, not limited or restricted. The untrammeled wilderness is one in which ecological systems and their biological and physical components are autonomous and free from human intervention. By contrast, human actions that restrict, manipulate, or control the natural world within wilderness degrade the *untrammeled* quality. While connected, the *untrammeled* quality is distinct from the *natural* quality. The former applies to human actions, while the latter applies to the effects of those actions.

Attributes of the *untrammeled* quality

The wilderness within Sequoia and Kings Canyon National Parks has clearly been "affected primarily by the forces of nature." Unbridled natural forces and the interaction of native species predominate.

Other than four relatively small dams in the East Fork Kaweah River drainage, no dams impede the natural flow of water within the parks' wilderness. Rivers are dynamic, as bars and pools migrate and logjams form and break up. Landforms are affected largely by natural forces such as hydrologic processes and glaciation (Figure 6).

Lightning ignited fires are common in the forested middle elevations (from 4,500 to 9,000 feet) of the wilderness. From 1980-2008, 57% of the 791 lightning ignitions recorded in wilderness were not suppressed or controlled; they burned nearly 53,000 acres (National Park Service 2012b). Vegetation

Figure 6. Evidence of past glacial forces is visible throughout much of the parks' wilderness.
(NPS Photo by E. Frenzel)

dynamics such as succession and disease occur unimpeded. Human interventions following disturbances in wilderness such as floods, fires, or avalanches,
occur only rarely as necessary for maintenance of trails and administrative structures).

It is believed that most animals in the wilderness behave naturally: some wary, some curious, but generally showing little to no behavioral disruption as the result of human presence, except in rare cases. Bighorn sheep have shown they adapt to human and recreational stock presence with few to no avoidance or flee behaviors exhibited (Klinger et. al. 2014). Fish-stocking programs were discontinued in the parks in 1988 (Christenson 1977, and Boiano and Meyer 2011) and there are no programs of population control on native predators. Populations of native plants and all but a few native animals proceed according to their life cycles without direct manipulation by humans.

Threats to the *untrammeled* quality

While most of the physical features, flora, and fauna within the wilderness are unimpeded by human intervention, the NPS authorizes manipulation of some natural resources and processes. Nearly all management intervention carried out in the parks' wilderness is done to restore or preserve ecosystems in a natural, resilient, or sustainable state (National Park Service 2004, and Graber 2003).

One action that impacts the *untrammeled* quality in wilderness is the selective removal of targeted nonnative species. This includes restoration of selected high-elevation (9,000 feet and above) aquatic ecosystems by removing nonnative trout (Figure 7). The introduced trout are aquatic predators that cause profound changes in food webs and have notably impacted some native species (Bradford et. al. 1993, Knapp and Matthews 2000, Knapp 2005, and Finlay and Vredenburg 2007). From 2001 to 2011, a total of 43,812 nonnative trout were removed from five lake basins in Kings Canyon National Park and one lake basin in Sequoia National Park (Boiano and Meyer 2011).

The NPS also actively removes approximately 19 nonnative plant species using combinations of hand pulling, tarping, and herbicides. Strategic and substantial plant removal from wilderness began in 2000 and has been focused in the mid- to low-elevations in the parks, especially in two areas: the Roaring River and lower Kern River drainages (Tu et. al. 2013).

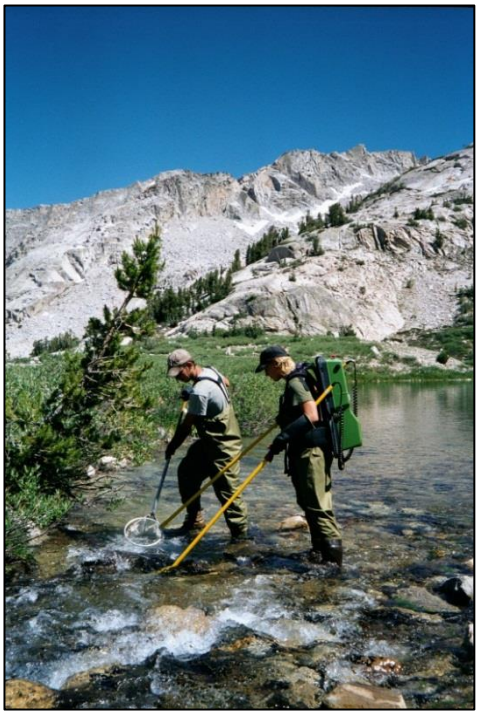

Figure 7. Electrofishing is a method used to kill and remove nonnative fish from outlet streams near lakes where mountain yellow-legged frogs are being restored. *(NPS photo)*

Intervention in the behavior or lives of native plants and animals also affects the *untrammeled* quality. In the parks' wilderness, these include management of human-bear conflicts through hazing, and on rare occasions, capturing or killing bears (Mazur and Gammons 2011). Capturing, collaring, and tagging animals for research also diminishes the *untrammeled* quality of wilderness. The most notable species in this regard is the endangered Sierra Nevada bighorn sheep. From when the sheep were listed as endangered in 1999, through 2010, some 195 sheep captures took place. These captures involved 143 individual sheep as several were captured more than once. Prior to 2011, approximately 18 sheep were collared and monitored with Very High Frequency (VHF) or Global Positioning Systems (GPS) (National Park Service 2011b). In 2011 and 2012, bighorn-sheep monitoring increased in anticipation of future trnaslocations to areas that wer histroically occupied by sheep; this prompted the capture of 91 sheep, 88 of which were collared. Not all of these actions occurred within the parks as the sheep move freely between the parks and the wilderness of Inyo National Forest. Other scientific activities permitted in the parks that affect the *untrammeled* quality of wilderness include capturing animals to take tissue samples, harvesting seeds, installation of exclosures, and relocating native species (National Park Service 2011e).

Restoration of disturbed areas, such as campsites and trails, to more natural conditions also causes short term effects on the *untrammeled* quality of wilderness. Wilderness rangers have obliterated and restored hundreds of campsites in order to direct use away from sensitive areas and to reduce and/or concentrate impacts and signs of human presence (Cole and Parsons 2013). Park trail crews regularly remove or mitigate impacts caused by braided/multiple trails and trails through meadows or other sensitive areas (Figure 8). Large projects to reroute trails and restore meadows have recently been completed at Taboose Pass, Bubbs Creek, and Cloud Canyon (Karplus 2010). Between the late 1800s and the mid-1900s, large numbers of cattle and sheep were often grazed in montane and sub-alpine locales, leading to significant impacts to meadow and wetland ecosystems. From the 1940s into the 1970s, the NPS stabilized eroding meadows throughout the parks that had been heavily impacted by grazing (Neuman 1990).

Figure 8. California Conservation Crew restores a section of abandoned trail near Big Wet Meadow. *(NPS Photo by P. Rizzo)*

Interference in natural energy flows and disturbance processes is also an effect on the *untrammeled* quality of wilderness. Within 111 acres of potential wilderness additions in the East Fork Kaweah watershed, there are four dams that regulate water flow for commercial hydroelectric-energy generation.

Figure 9. Prescribed burn in Redwood Mountain sequoia grove, Kings Canyon National Park.*(NPS Photo by D. Schweizer)*

The most widespread and profound interference in disturbance processes within the parks is the management of fire (Figure 9). Periodic fire ignited first by lightning and later by Native Americans, shepherds, and land managers, is an important agent in shaping ecosystems and plays a critical role in the reproduction of giant sequoias and other species, especially in the middle elevations of the park (Caprio and Swetnam 1995, Caprio 2008, Caprio and Lineback 1997, Warner 1980, Kilgore and Taylor 1979, and Caprio 1999). However, from 1904 through 1968 NPS policy was to extinguish all fires within the parks (Bancroft et. al. 1985). This practice began to change for both Sequoia and Kings Canyon National Parks and the national park system in the 1960s. From 1980-2012, 41% of the 805 lightning ignitions recorded in wilderness were suppressed or controlled. In the same period, 93 prescribed fire ignitions in wilderness burned more than 37,000 acres (National Park Service 2012b). While law and policy allows wildfires to run their course in wilderness, external factors (such as air-quality issues, boundary concerns, weather conditions, and the availability of firefighter resources) can lead managers to suppress wilderness fires. Both suppression of lightning ignited fires and ignition of prescribed fires contribute to a decrease in the *untrammeled* quality of the parks' wilderness.

Unauthorized impacts on the *untrammeled* quality are almost entirely due to illegal marijuana cultivation. These operations introduce nonnative species, divert water flow, disturb animal behavior and life cycles, and introduce large quantities of foreign chemicals such as fertilizers, herbicides, and pesticides into the parks' ecosystems (National Park Service 2008). These operations have been most prevalent in the lower elevations of the Kaweah River drainage.

Status and trends in the *untrammeled* quality

Participants were generally in agreement that the wilderness in the parks is largely untrammeled and that it especially has the appearance of being unimpeded by human actions. Both rangers and workshop participants believed this quality was primarily intact, with some small-scale impacts. This informed but subjective rating for the *untrammeled* quality is potentially attributable to the large size and ruggedness of the park. People have had limited resources or reasons to intervene in physical and biological processes in a widespread or visible way at the landscape scale in this wilderness. Playing a key role in this was the relatively early protection these wild lands were afforded by national park and other protected public-land status; this removed the threats of late 19th- and early 20th-century resource-extraction practices such as logging and mining. Moreover, growing societal and organizational sensitivity to wild-land values encouraged humility and management restraint.

Many of the actions of the past and subsequent effects on the *untrammeled* condition have been discontinued or reduced. These include wholesale fire suppression, fish stocking, control of forest pathogens and pests, control of predator populations, and large-scale meadow restoration and manipulation. Other actions that affect the *untrammeled* quality are generally decreasing as the parks realize gains from past actions such as managing human-bear conflict through better education and targeted restrictions, focusing on early detection of nonnative species, and the rerouting of trails and other infrastructure away from sensitive areas.

Figure 10. Sierra Nevada bighorn sheep ewe with radio collar. Monitoring of local populations provides important information for management of this endangered species. *(Photo courtesy of California Department of Fish and Wildlife)*

However, a majority of respondents felt that this quality has a notable potential to decline due to numerous and important difficult decisions yet to be made by park management on whether or not to intervene in natural systems in order to preserve and provide for resilience and sustainability. Climate change will likely have effects on ecosystems that may compel intervention or manipulation in order to meet agency mandates for preservation of ecosystems and their components (Graber 2003, and Hobbs et. al. 2010) (see details in the *Natural* section above). State or federal listing of threatened and endangered, sensitive, or high-value species (such as mountain yellow-legged frogs, [US Fish and Wildlife Service 2014]), may compel park managers to take action to preserve these species. For example, in 2011 and 2012 the park supported an effort that captured and collared 88 Sierra Nevada bighorn sheep in the parks and the adjoining

Inyo National Forest wilderness (see *Threats to the untrammeled quality* section above) (Figure 10). This was done in anticipation of translocating approximately 30 sheep over the next decade to unoccupied portions of their former range in the parks in order to facilitate species recovery (National Park Service 2011b). Another example involves air-quality problems in the southern San Joaquin Valley. During periods of poor air quality the parks' authority to allow naturally ignited fires to burn and to conduct prescribed fires may be curtailed in the interest of public health. The outcome of this on the *untrammeled* quality would be mixed: suppressing naturally ignited fires is an impact on the *untrammeled* quality, but so is conducting prescribed fires. The restriction of either naturally ignited or prescribed fires would have a negative effect on efforts to restore fire-adapted ecosystems to improve the *natural* quality.

While law and policy allows wildfires to run their course in wilderness, external factors (such as air quality issues, boundary concerns, weather conditions, and the availability of firefighter resources) can lead managers to suppress wilderness fires. Both suppression of lightning ignited fires and ignition of prescribed fires contribute to a decrease in the *untrammeled* quality of the parks' wilderness.

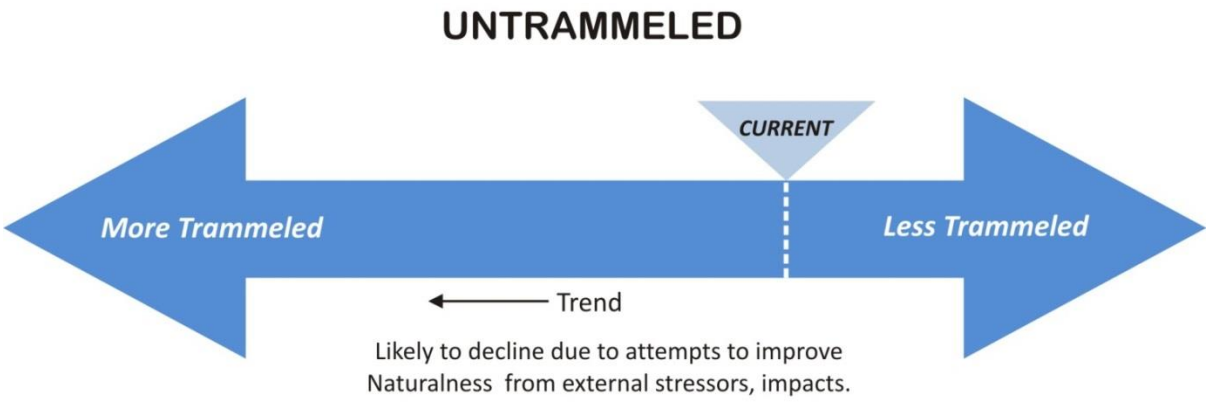

Figure 11. Graphic depicts estimates of current condition and anticipated trend on the Untrammeled quality of wilderness character.

UNDEVELOPED

The Wilderness Act states that wilderness is "an area of primeval character and influence, without permanent improvements or human habitation," "where man himself is a visitor who does not remain" and "with the imprint of man's work substantially unnoticeable" (Figure 12). The intent is to limit buildings, installations, habitations, mechanized equipment, and other structures and machines that humans use to dominate, modify, or occupy land.

Developments and use of mechanized equipment by the agency to administer wilderness have a negative effect on the *undeveloped* quality and may also affect *opportunities for solitude or a primitive and unconfined type of recreation.* Within the interagency wilderness character framework, the *undeveloped* quality is measured by the extent of non-recreational developments and activities. By contrast, infrastructure with the primary purpose of serving recreational and related visitor- oriented functions is measured under the *solitude or a primitive and unconfined type of recreation* quality (Landres et. al. 2008, and National Park Service 2014). Therefore the key to determining whether a structure or activity has an effect on the *undeveloped* quality or on the *solitude or a primitive and unconfined type of recreation* quality is its purpose. If the purpose is to administer the area as wilderness, it affects the *undeveloped* quality. If the purpose is to assist the public in recreating in wilderness it affects the *opportunities for solitude or a primitive and unconfined type of recreations* quality.

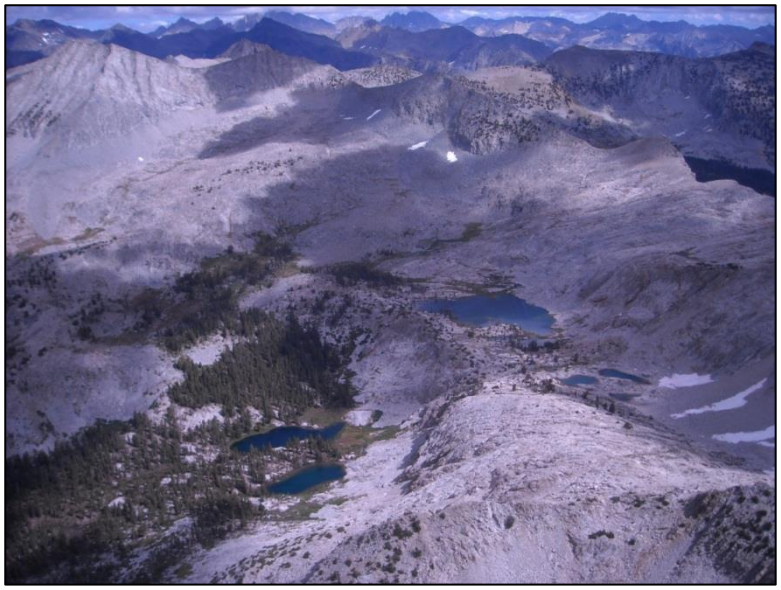

Figure 12. Evidence of humans is substantially unnoticeable in this aerial photo of Blue Canyon, Kings Canyon National Park.
(NPS Photo by E. Frenzel)

Attributes of the *undeveloped* quality

The wilderness of Sequoia and Kings Canyon National Parks remains largely primeval with few permanent developments devoted to administering wilderness. Many of the developments predate wilderness designation. Several have scientific or historic and cultural value.

Roads and trails that ease access to otherwise difficult-to-access areas allow humans to dominate the wilderness. With the exception of the historic Colony Mill and Hidden Springs roads in the North Fork Kaweah River drainage (both now closed to vehicles), and the access road to Oriole Lake inholdings, there have been few roads of any consequence in what is now the parks' wilderness. The maintained trail network in the parks wilderness is relatively extensive, with approximately 690 miles of maintained trails in the 1,309 square miles of wilderness (National Park Service 2011d). Almost all trails were present in some form prior to wilderness designation, with some routes having been established by American Indians centuries ago. Importantly, no roads or trails in wilderness exist for administrative, non-recreational purposes.

Administrative buildings, such as patrol cabins and ranger stations, tend to be located near primary trails: the High Sierra Trail, the John Muir Trail, and the Pacific Crest National Scenic Trail. Most of these structures pre-date wilderness designation. Six of the hard sided ranger stations and all three patrol cabins are historic structures built before wilderness designation, and may contribute to wilderness character as cultural resources (Table 1). All of these historic structures are either listed on, or have been determined eligible for listing on, the National Register of Historic Places (NRHP) with the concurrence of the California State Historic Preservation Office. Far from being permanent habitations, these ranger stations are usually staffed only for three to four months during the peak-use summer season.

The parks have a long history of using primitive transportation in the administration of wilderness. Rangers patrol on foot or with saddle and pack stock. Packers transport supplies, materials, and staff to and from remote wilderness locations using horses and mules, supporting trail and facility maintenance, ranger activity, resource management and research, and fire management. Primitive tools are also used in the maintenance of trails and buildings.

Threats to the *undeveloped* quality

There are several kinds of non-recreational developments, and some generally prohibited (as opposed to absolutely prohibited) activities that occur in the parks' wilderness. Many of these can be allowed for administering visitor use and protecting wilderness character, provided they have been analyzed and determined to be the "minimum requirement" under provision of the Wilderness Act (Section 4(c)). However, even if these activities are determined to be the minimum required action, they are an impact the *undeveloped* quality.

The Wilderness Act states that there should be "no structure or installations" except "as necessary to meet the minimum requirements for the administration of the area for the purposes of this Act" – the "minimum requirement" clause (Wilderness Act of 1964). Additionally, Section 2(c) of the act states that wilderness "may also contain…other features of…historic value." In the parks' wilderness, there are 15 ranger stations (generally staffed in summer months) and three patrol cabins (not staffed) of differing ages and varying

architectural styles:15 hard-sided (Figure 13), two tents, and one yurt (the soft-sided tents and yurt are on platforms, and are erected and taken down seasonally, though much equipment remains on-site) (National Park Service 2011i) (Table 1). Staffed ranger stations often include other adjacent features and accessory structures such as solar panels, radio antennas, storage boxes, outbuildings, privies and, in three cases, fenced pastures. In most years, 10 -14 seasonal wilderness rangers staff many of the stations from late June through late September. The three patrol cabins have not been staffed over the past three decades. Six of the structures (five stations and one patrol cabin) are also used intermittently as shelters by snow surveyors in the winter.

Figure 13. Rae Lakes Ranger Station, Kings Canyon National Park. Example of a hard-sided station, as rebuilt in 2011. *(NPS Photo)*

Table 1. Ranger stations that fall within four categories based on their physical structure and their historic status.

Hard-sided, non-historic ranger stations	Hard-sided, historic ranger stations	Soft-sided, non-historic ranger stations	Hard-sided, historic patrol cabins
Bearpaw Meadow, Charlotte Lake, Crabtree Meadow, LeConte Canyon, Rae Lakes, Roaring River	Hockett Meadow* (in proposed wilderness), Kern Canyon*, McClure Meadow, Pear Lake, Rock Creek, Tyndall Creek	Bench Lake, Little Five Lakes, Monarch Divide	Quinn Meadow (in proposed wilderness), Redwood Meadow*, Simpson Meadow

* = These also have associated outbuildings with historic status.

In addition to the ranger stations and patrol cabins, the NPS establishes temporary administrative camps, which may have tent platforms, food- and equipment-storage boxes, fire rings, sumps, pit toilets, rain/shelter tarps, and other equipment. These camps, primarily used by trail maintenance and natural resource management crews, might be set up for weeks or months during the summer, with some equipment, such as storage containers, left in the wilderness year-round for the duration of a project. For the past decade, roughly six to eight trail-maintenance and construction crews and one to five resource management crews (conducting, for example, wildlife surveys, nonnative plant removal, vegetation monitoring, and aquatic habitat restoration) have operated in the park's wilderness each summer. These crews combined often total more than 100 people.

Other installations used for wilderness administration include radio repeaters that allow park employees to communicate with frontcountry personnel via hand-held radios. Repeaters generally consist of antennas, a weatherproof container that houses electronics and batteries, and solar panels. There are six such repeaters on relatively remote prominences in the park's wilderness: Evolution, Forgotten, Gould, Palmer, Paradise, and Windy.

Research and monitoring are other nonrecreational activities that can impact the undeveloped quality of wilderness. Some research activities, monitoring programs, and fire-management operations rely on remote instrumentation to collect data, such as ten remote year-round snow sensors (SNOTEL) and two seasonal remote-area fire-weather stations (RAWS). These consist of snow "pillows," transmission towers with associated equipment, and weather-data-gathering arrays that occupy in excess of 100 square feet and stand up to 30 feet tall. Other temporary installations include stream-flow and other monitoring devices. Researchers also rely on permanent and temporary markers to relocate study plots. Studies with plot markers in wilderness include forest demography, fire effects, wetlands and meadow monitoring, natural resource inventory, and forest inventory and analysis (Figure 14). Plot, tree, and other markers (many of which are small, such as tree tags and rebar stakes) total in the thousands throughout the wilderness.

Figure 14. Labeled cap on rebar marking wetland monitoring plot. *(NPS Photo by J. Jones)*

A number of developments have been placed in wilderness for natural-resource protection. There are nearly 90 food-storage boxes placed along popular trail corridors to prevent bears from obtaining human food and scented items (National Park Service 2011h). Some 500 signs mark trail junctions, indicate campfire restrictions, and display local regulations such as prohibitions on use of restored campsites (National Park Service 2011j). These items reduce the undeveloped quality but help to protect certain natural features such as subalpine forests and lakeshores, and they provide orientation information to visitors (National Park Service 1986a). There are some 50 hitch rails for stock users and more than five miles of drift and pasture fences in approximately 55 separate installations, of which most have associated stock gates (National Park Service 2011g). Hitch rails minimize pawing of tree roots by tied stock, while fences prevent stock from accessing sensitive areas as well as containing administrative stock at the Hockett, Kern, and Roaring River ranger stations. Administrative developments also include less visible structures such as several cave gates to prevent access and vandalism to sensitive resources.

Inholdings and other non-wilderness lands surrounded by wilderness also decrease the undeveloped quality. These parks contain a variety of Designated Potential Wilderness Additions (DPWA), as well as two areas of private-property inholdings. DWPAs are areas designated by Congress to be wilderness, but in which an existing use that does not conform with wilderness characteristics and mandates is allowed to continue. If the use is discontinued, the NPS can achieve full designation through an administrative process. Two utility easements are DWPAs: 12 acres in the Middle Fork Kaweah River drainage and 21 acres in the South Fork Kings River drainage. In the Mineral King area, there are 111 acres of DWPAs encompassing four lakes expanded by dams to create reservoirs in the early 20th century. Two DWPAs exist due to commercial enterprises; the Pear Lake Ski Hut lodging operation (5 acres, winter only) and the Bearpaw High Sierra Camp lodging and dining operation (32 acres). The two private property inholdings in wilderness (Oriole Lake and Empire Mine areas) total about 25 acres, with a related road in wilderness allowing restricted motorized access to the Oriole Lake properties.

The Wilderness Act prohibits the use of "motorized equipment…landing of aircraft…and other form[s] of mechanical transport" except as "as necessary to meet the minimum requirements for the administration of the area for the purposes of this Act" (Wilderness Act of 1964). Mechanical transport and motorized equipment is used regularly by the NPS to administer the park's wilderness, if determined to be appropriate through a Minimum Requirement Analysis process (see *Threats to the Undeveloped Quality* section above). Each year, crews use chainsaws to clear trails and cut firewood for use by crews and at wilderness ranger stations; chainsaws are also used in fire management. Motorized rock drills are occasionally used to maintain trails. Helicopters are frequently used to bring supplies and tools to ranger stations, trail crews, and resource-management crews. Helicopters are also used to maintain the six radio repeaters. Four dams and 15 snow-survey locations in wilderness are often accessed and maintained using helicopters. Helicopters are used to respond to fires, search and rescue (SAR) missions, and medical emergencies (EMS) in wilderness (Figure 15). Approximately one-third of the 100 or so SAR and EMS incidents each year involve evacuation of a park visitor from the wilderness by helicopter (Browne 2010). In years when large search operations occur, emergency helicopter landings may increase dramatically. Over the ten-year period from 2003 through 2012, there was an annual average of 573 hours of helicopter flight time in the parks; note that this includes flights within and outside wilderness and may not involve landings (National Park Service 2012a). Non-emergency helicopter landings (defined as any air delivery or removal of people or material, or when aircraft skids touch ground) in the park's wilderness number around 175-250 per year (National Park Service 2012c).

Figure 15. Example of a rescue conducted via helicopter in the Sequoia-Kings Canyon Wilderness. *(NPS Photo)*

Status and trends of the *undeveloped* quality

Participants in the surveys, workshops, and interviews agreed that, while there are many administrative developments in wilderness, the effects of these are diluted by the vast amount of *undeveloped* area and are generally unnoticeable. There was general agreement that the state of the *undeveloped* quality was on the high end of the spectrum (workshop rating was 65%; ranger average rating was 73%). Both groups believed that this quality was on a positive trend.

As with most prominent signs of human presence in wilderness, developments are concentrated near trails. This is especially true of installations and equipment use. The notable exceptions are radio repeaters, research facilities, and helicopter use – these uses may also impact off-trail areas.

Participants noted that there was both the room for improvement in the *undeveloped* quality of the park's wilderness, and the ability to do so; it may be the easiest of the four qualities to improve. This is largely because gains may be accomplished through internal controls, such as evaluating actions through minimum-requirement/minimum-tool analyses, working with researchers to reduce impacts, and removing abandoned or unneeded equipment, materials and structures. Technology such as global positioning systems may reduce the need for fixed monuments and markers and minimize the footprint and subsequent intrusiveness of installations through miniaturization.

Wilderness visitation has been stable to slightly increasing since 1995 (National Park Service 2011m), so demand for administrative developments that facilitate management of visitor impacts (such as radio repeaters, ranger stations, and trailcrew camps) and the need for emergency services (such as helicopter evacuations) are unlikely to decrease. In the future, there may be even greater call for park intervention in visitor mishaps, as use of hand-held electronic signaling devices and satellite phones increases. The demand for additional instrumentation (such as stream gauges and snow sensors) may also increase as park management and scientists seek to understand the effects of climate change in the Sierra Nevada.

Furthermore, the active NPS stock-packing program and availability of contract packers could allow helicopter use to be replaced with stock use in many non-emergency situations. Strong continued emphasis on developing and utilizing primitive skills and tools to accomplish trail maintenance and construction operations,, combined with a high level of professionalism among trail crews could also reduce activities that impact the undeveloped quality (Figure 16).

Figure 16. Park staff clearing a trail using a crosscut saw. *(NPS Photo)*

Since designation, the undeveloped quality of the park's wilderness has improved. Though there have been some actions that have led to negative impacts (the installation of food-storage boxes and the rebuilding of three ranger stations, for example) have been more than offset by other administrative changes. An increase in use of primitive tools for trail maintenance, combined with stronger management scrutiny of resource-management and research activities, reduced helicopter landings for administrative purposes, and removal of unnecessary management facilities, have led to a positive change in the *undeveloped* quality of the park's wilderness (Figure 17).

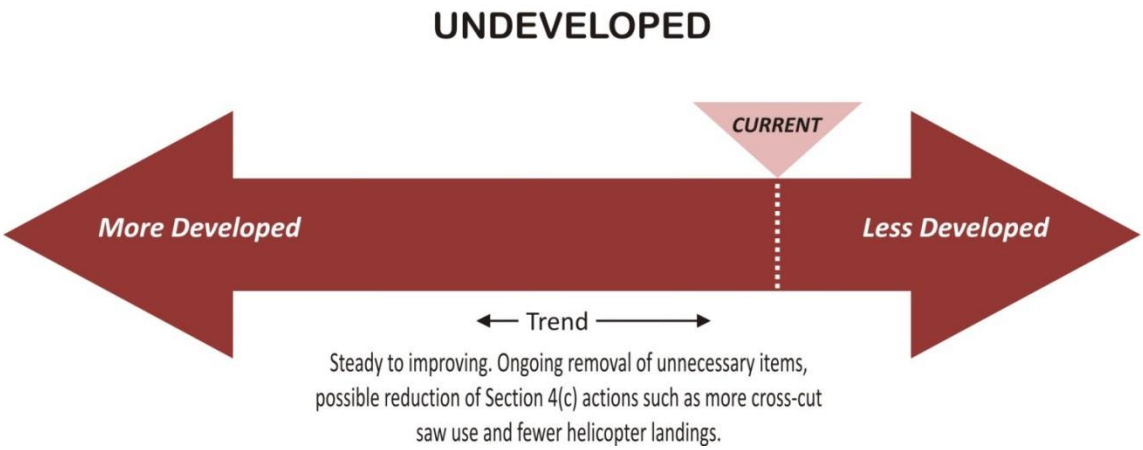

Figure 17. Graphic depicts estimates of the current status and anticipated trends on the Undeveloped quality of wilderness character.

OPPORTUNITIES FOR SOLITUDE OR PRIMITIVE AND UNCONFINED RECREATION

The Wilderness Act states that wilderness offers "outstanding opportunities for solitude or a primitive and unconfined type of recreation." Primitive and unconfined recreation and solitude provide a chance for modern humans to connect with the natural world, to practice traditional skills, and to have transformative personal experiences. Infrastructure that reduces opportunities for solitude or primitive recreation (such as buildings) may also affect the *undeveloped* quality. However, within the "Keeping It Wild" framework, recreational developments and activities are evaluated under the *solitude or a primitive and unconfined type of recreation* quality while infrastructure with the primary purpose of serving administrative purposes is evaluated under the *undeveloped* quality (Landres et. al. 2008).

The *opportunities for solitude or a primitive and unconfined recreation* wilderness quality is largely influenced by the perceptions of individuals and is often difficult to evaluate. This quality varies greatly from one user to another as words such as solitude, primitive, and unconfined mean different things to different people.

Attributes of the opportunities for *solitude or primitive and unconfined recreation*

Despite being located in the most populous state in the nation and close to an area of rapid population growth (Mackun and Wilson 2011), the park's wilderness has outstanding opportunities for the public to follow primitive pursuits and find solitude. Activities such as hiking, climbing, fishing, rafting and kayaking, skiing, backpacking, and riding and packing with stock are available. A visitor can experience danger, adventure, and physical and mental challenges in swift and cold rivers and streams, perennial snowfields, remote lake basins, steep canyons, and on high peaks and passes. Many have celebrated the dual nature of conditions in the southern Sierra Nevada: fierce storms followed by clear days, and impressively rugged topography that is readily accessible via trail or cross-country travel. One author calls it "the best place for the practice of mountains" (Secor 2009).

Figure 18. Rugged terrain, a limited trail network, and expansive views contribute to a feeling of solitude and provide opportunities for primitive and unconfined recreation. Looking south from Cartridge Pass in Kings Canyon National Park. *(NPS Photo by G. Fauth)*

Backpacking along the 690 miles of maintained trails is the most common form of primitive recreation, but the wilderness also offers excellent rock climbing and mountaineering. It boasts enormous granite monoliths such as Angel Wings and Tehipite Dome, as well as numerous 13,000 and 14,000-foot peaks with routes ranging in difficulty from Class 1 walk-ups to technically demanding Class 5 climbs (Secor 2009). It contains the summits of 12 of the 15 peaks in California that are 14,000 feet or higher, including Mount Whitney, at 14,494 feet the highest peak in the nation outside of Alaska. In addition, wilderness kayaking on the Kings, Kaweah, and Kern rivers offers an opportunity to experience challenging whitewater in a location unlike any other (National Park Service 2011k, and American Whitewater 2012). The parks provide excellent opportunities for riding and packing with horses, mules, burros, and llamas; the Roaring River and Hockett Plateau areas, and many others, have a long and rich tradition of recreational pack-stock use extending more than 140 years (Jackson 2004). This activity

preserves traditional primitive skills that have been used for generations to transport people and equipment into the wilderness, enriching experiences and facilitating the public purposes of wilderness.

An exceptional characteristic of this wilderness is a sense of vastness that sets it apart from many other wilderness areas (Figure 18). The Sierra Crest portion lies within the second-largest unbroken wilderness tract in the contiguous United States. Furthermore, the parks' wilderness protects a portion of the Sierra Nevada in which no roads cross the range for over 175 miles. When the roads over Tioga Pass and Sherman Pass close during the winter, this automobile-free area becomes even bigger, stretching for 280 miles from Carson Pass in the north to Walker Pass in the south. A visitor may feel dwarfed by the immensity of this landscape. Some described it as being "like you're in the center of the world completely surrounded by mountains", and noted that in these parks the wilderness "feels bigger". The large size of the parks and the adjacent wildernesses also makes possible long trips that offer the time and distance to thoroughly disconnect from modern civilization. Hikers on the Pacific Crest National Scenic Trail and the John Muir Trail may travel for days or weeks without crossing a road, greatly heightening the feeling of being removed from the contemporary world. Because of the large size of these adjoining wildernesses and their rugged topography, development outside the parks' wilderness usually goes unseen. These physical characteristics considerably limit communication with the "outside" world via cell phones and other electronics and may strongly contribute to a feeling of *solitude*.

The park's wilderness is also distinctive in offering opportunities for *unconfined recreation*. Travelers, once accommodated within trailhead quotas, are almost always free to change their itineraries mid-trip and select whatever routes or destinations suit their imagination. This ability to freely pick and choose one's path contributes notably to the sense of *solitude* and of being "*unconfined*."

Perhaps the most exceptional aspect of the park's wilderness—one that both park visitors and employees identified consistently—is the opportunity to travel through truly undeveloped and primitive areas without trails. This is due to the combination of low density of maintained trails (690 miles in 1,309 square miles of wilderness [National Park Service 2011d]), suitable terrain, and the large size of the park. Off-trail travel in the higher, open, rocky elevations of the Sierra Nevada is possible in a way that would be difficult in the vegetation of a dense forest or thick chaparral. The trailless areas of the wilderness in particular provide a glimpse into the landscapes of the past. The ability to leave the trail behind contributes greatly to the *unconfined* quality of the park's wilderness and fosters feelings of discovery, exploration, and the wonder of the unknown.

The opportunity to leave the trail means that *solitude* may easily be found even during the busiest parts of the summer. *Solitude* also prevails outside of the summer season. While an average of more than 25,000 people visit the wilderness each year (National Park Service 2011m), visitation declines sharply as snow blankets the mountains throughout winter and spring. Visitors during these times are unlikely to encounter another person, and skiers look forward each year to the Sierra's renowned spring corn snow (Figure 19).

Figure 19. Skier enjoying the solitude of spring. *(NPS Photo by E. Frenzel)*

On or off trail, on snowy passes or through verdant meadows, via technical or casual travel, the parks' wilderness provides a great diversity of experiences. These kinds of opportunities for reflection, spiritual renewal, and personal growth and challenge inspired the framers of the Wilderness Act and continue to delight Sierra Nevada novices and aficionados alike.

Threats to *opportunities for solitude or primitive and unconfined recreation*

Developments that serve the primary purpose of supporting or facilitating public recreation decrease the primitive quality of wilderness. The 690 miles of trail are technically such recreational developments, though they also provide opportunities for backpackers, stock users, day hikers, and other recreationists to experience the wilderness in a *primitive* manner. Many of these trails predate wilderness designation and were developed from existing American Indian routes through regular use or constructed by shepherds and ranchers, the U.S. military, the Civilian Conservation Corps, and other organizations late in the 19th and early 20th centuries. There are also 33 bridges and thousands of other human-built trail features (including causeways, boardwalks, rock walls, tunnels, and laid-rock tread), historic stone shelters on Muir Pass and Mount Whitney (though the Mount Whitney structure was originally built for scientific investigation), and hundreds of signs in the wilderness that aid travelers (Figure 20). One commonly expressed public sentiment is that the amount of maintained trails and bridges is appropriate and offers a continuum of challenges and experiences that are consistent with the purposes of wilderness (Fauth and Tarpinian 2011, and National Park Service 2011k).

Figure 20. Roaring River Bridge, Kings Canyon National Parks. *(NPS Photo)*

A common complaint among the public, rangers, and workshop participants was that aircraft overflights degrade the feeling of *solitude* in the park's wilderness. Most cited the frequency and high volume of military jets, many from Naval Air Station Lemoore flying eastbound over the parks to their training airspace and then returning westbound over the parks back to base. NAS Lemoore annually originates nearly 4,800 flights, which would equate to nearly 9,600 transit flights over the parks per year (US Navy 2013). There are also thousands of other flights in the R-2508 Military Aviation Training Complex, which overlays the eastern half of the parks, originating out of the Owens Valley east of the parks. The public has also generally expressed that military aircraft and helicopter flights over the parks disturb their sense of *solitude* with statements such as "there is simply too much Park Service helicopter traffic in the backcountry," "[use the] helicopter only as a last resort," and "nothing is more intrusive than being buzzed by low-flying jets." Other members of the public are more accepting of overflights, whether by military aircraft or by the parks' contracted helicopter (National Park Service 1999).

A quiet, but just as pervasive, sign of modern civilization is the tide of air pollution that reaches far into the wilderness, particularly along the west slope. Aside from the damage to the natural quality of the wilderness, it can obscure scenic vistas. Opportunities for viewing the night sky may be decreased by air pollution, light pollution from nearby urban areas, or a combination of the two (Duriscoe 2012).

One of the primitive joys of hiking in the Sierra is drinking untreated, clear, clean water. Though the water of the parks is primarily very clean, there are some places and times when contamination from human and animal feces (both native animals and recreational stock) may make it unhealthy to drink untreated water (Clow et. al. 2013). High visitor density in some areas prompted the construction of composting toilet buildings (at Pear and Emerald lakes), installation of privies (at Paradise Valley, Monarch Lake, Crabtree Meadow, Kern Hot Springs and other areas) and directives to pack out human feces (Mount Whitney area). These structures and directives are a negative impact to the *unconfined* recreation aspect of wilderness.

Restrictions placed on visitors can reduce the *unconfined* quality of wilderness. In the parks, regulations are established to protect natural features, preserve opportunities for *solitude*, and protect the primitive *natural* and

undeveloped qualities of the park (National Park Service 1986a). Overnight visitor use is limited during the most popular time of year (late May to late September) by daily trailhead entry quotas (limits). Party size is limited in order to keep campsites small, prevent formation of use trails in areas without constructed trails, and preserve the feeling of *solitude* for other groups. Campfire prohibitions above specified elevations and in select locations protect slow-growing subalpine forests from depletion of ecologically and scientifically important downed wood. Camping along lakeshores or other water bodies is prohibited to protect water quality and fragile riparian banks and vegetation. Three popular destinations require the use of designated campsites (Pear and Emerald lakes, Bearpaw Meadow, and Lower Paradise Valley), and areas near frontcountry trailheads are closed to camping to prevent overuse. The location, timing, and amount of grazing by stock is restricted in order to protect soils and vegetation, and large portions of the parks are closed to all stock travel (National Park Service 1986b).

Administrative presence may also impact opportunities for *solitude* and *unconfined* recreation. Rangers, trail crews, and natural-resource crews are stationed seasonally in the park's wilderness to manage visitor use and to improve primitive and natural conditions in the wilderness. However, interaction with agency personnel may reduce the *unconfined* feeling or opportunities for *solitude* for some park visitors (Fauth and Tarpinian 2011, and National Park Service 2011k). The expectation of swift rescue or aid, while unrealistic, also reduces opportunities for self-reliance and diminishes the sense of challenge that comes with personal responsibility.

The perception and personal feelings about what constitutes a primitive experience to individuals also impacts opportunities for *primitive and unconfined recreation*. Personal perceptions of the "right" way to experience wilderness are highly variable and can lead to conflict among wilderness users. This presents a perplexing issue for management (Fauth and Tarpinian 2011, and National Park Service 2011k). Some visitors feel that electronics such as GPS, portable music listening devices, satellite phones, and cell phones bring modern civilization into the wilderness and are thus inappropriate (National Park Service 2011k). Others are especially sensitive to party size, and their feeling of *solitude* is diminished by larger groups. For some visitors, any sign of other people in off-trail areas diminishes their feelings of *solitude*. Packing with stock is a traditional primitive activity enjoyed by some, while others find their experience diminished by the presence of recreational pack animals in the wilderness (National Park Service 2011k, and Watson et. al. 1993) (Figure 21).

Figure 21. Wilderness stock trip. *(NPS Photo)*

The Wilderness Act prohibits "commercial enterprise" but allows commercial services "to the extent necessary for activities which are proper for realizing the recreational or other wilderness purposes of the [wilderness] areas" (Wilderness Act of 1964). These parks permit (through a formal process) guided hiking and mountaineering trips and hired stock trips throughout much of the wilderness. The seasonally operated Bearpaw Meadow High Sierra Camp offers amenities such as tent cabin lodging and food service (Figure 22). Public sentiment on commercial services is divided between those who would like more amenities, to those who feel current levels and types are appropriate, to those who feel current levels of commercial activities in wilderness are excessive and decrease their sense of *solitude* and are inconsistent with the purpose of wilderness (National Park Service 2011k).

Figure 22. Bearpaw Meadow High Sierra Camp structure, Sequoia National Park. *(NPS Photo)*

Status and trends of *solitude or primitive and unconfined recreation*

Rangers and workshop participants echoed public comments that the park's wilderness has great *opportunities for solitude* and for wilderness-appropriate *primitive recreation*. Workshop participants were divided on whether it would get better or worse, while rangers were divided on whether there would be no change or it would get slightly worse. Both groups commented that the long-term trend is one of notable improvement relative to the 1970s, when the popularity of backpacking brought waves of new, inexperienced visitors to the wilderness. Visitor-use data from 1990 to 2010 indicate that visitation is lower in terms of total numbers of permits, people, and visitor-use nights relative to 1970 to1990 (National Park Service 2011m). A campsite survey and inventory conducted in 2006-2007 and subsequent analysis shows that wilderness campsites have reduced in number by 45% relative to the late 1970s to early 1980s, from approximately 7,700 to 4,000 reducing the signs of human presence and improving opportunities for solitude. This survey also showed that campsite impacts in 2006-2007 also were 28 % less than those of the late 1970s to early 1980s, from mean condition class 2.08 to 1.50, on an exponential scale of 1 to 5 (Cole and Parsons 2013).

Given the diversity of desired wilderness experiences, the parks have sought to provide a variety of conditions and situations within the framework and context of the Wilderness Act so that multiple types of wilderness adventurers can find their own preferred individual wilderness experience. Feedback from the public indicates that (with some dissenting opinions) this strategy has generally succeeded at maintaining the *opportunities for solitude or primitive and unconfined recreation* quality (Fauth and Tarpinian 2011, National Park Service 2011k, and Martin and Blackwell 2013).

One important trend is the increasing proportion of visitation to the Mount Whitney area and along the John Muir Trail and Pacific Crest National Scenic Trail (Figure 23). This has resulted in greater crowding, a decrease in *solitude*, and an increase in the signs of other people along this shared trail corridor. There are some other very popular trail corridors as well (for example, the High Sierra Trail) with similar issues. This presents a utilitarian conundrum for management as greater numbers of people visiting a particular area decreases *solitude* in that area, but conversely allows more people to experience *primitive recreation*. At the same time, off-trail

Figure 23. Hikers on the summit of Mt. Whitney; historic shelter visible in the background on right. *(NPS Photo/R. Pilewski)*

areas appear to be receiving relatively light use, which would present greater opportunities for *solitude* in these places.

Information readily obtained from the internet may have both deleterious and beneficial effects on *opportunities for solitude or primitive and unconfined recreation*. On one hand, photographs, route descriptions, and blogs with the latest conditions can reduce the sense of discovery for visitors and may result in more people visiting currently quiet locations. On the other hand, information explaining proper wilderness behavior and how to access less-visited areas of the wilderness might help reduce the impacts of visitors on the environment and each other's experiences, as well as disperse use (Cole et. al. 1997).

Some external factors that affect *solitude* have been improving (e.g., the number of low-level military overflights has decreased), while others are unlikely to change in the foreseeable future (e.g., poor air quality and visitor preference for the Mount Whitney area). It is reasonable to assume that this quality will remain at a high level and may improve as the parks take actions to ensure proper types and amounts of use are allowed in the wilderness.

Since designation, the *opportunities for solitude or a primitive and unconfined type of recreation* quality has improved. *Solitude* has been affected primarily by use levels, as those of the recent past are only about 2/3 of the levels at time of designation. Current use patterns also vary from those of the past, with present use tending to concentrate along iconic trails (e.g., John Muir Trail) and at key destinations (e.g., Mount Whitney) as opposed to past use being more dispersed. This may reduce solitude opportunities at these locations, but overall people have more opportunities to experience *solitude* by choosing alternative less popular areas. The ability of the public to have primitive and unconfined recreation has remained relatively unchanged, with similar types of primitive recreation, e.g., backpacking, using stock, kayaking and rafting, and climbing, remaining popular and accepted (Figure 24).

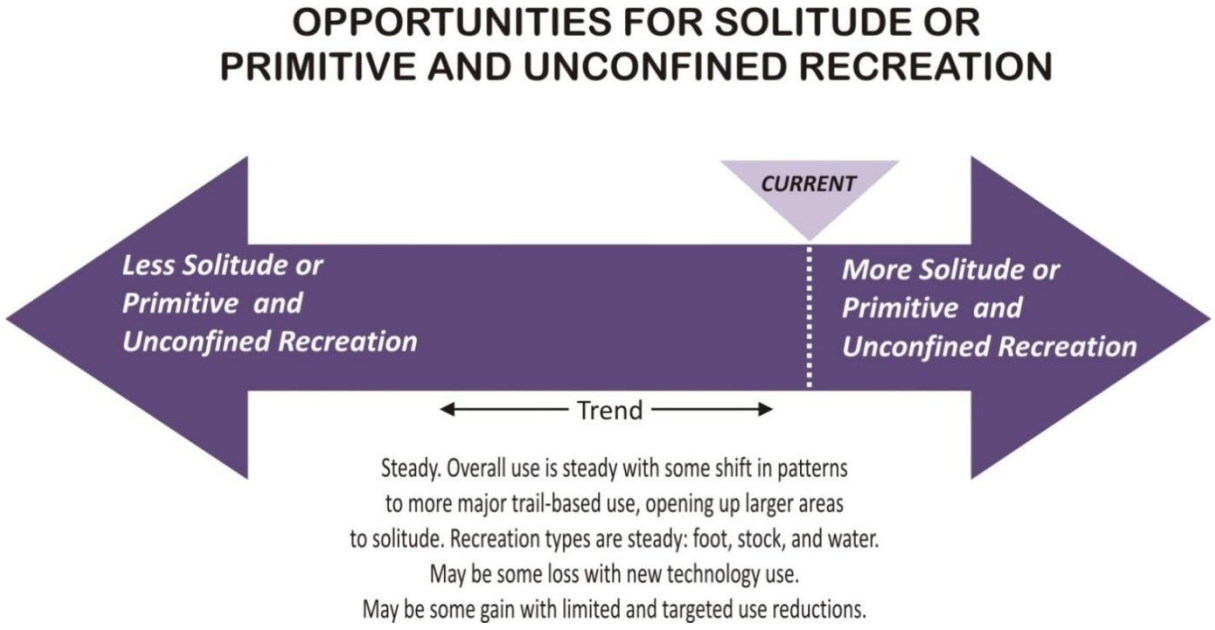

Figure 24. Graphic depicts estimates of the current status of Opportunities for Solitude or Primitive and Unconfined Recreation in the parks' wilderness.

OTHER FEATURES

All wilderness shares the four principal qualities of wilderness character: *untrammeled*, *undeveloped*, *natural*, and *opportunities for solitude or primitive and unconfined recreation*. However, the Wilderness Act also provides for protection of "…ecological, geological, or other features of scientific, educational, scenic, or historical value" that contribute to wilderness character. Many of these "*other features*" are so integrated within the four primary qualities that it is ineffective, problematic and unnecessary to separate them out as distinct elements or aspects**.** However, given that a majority of Sequoia and Kings Canyon National Parks is wilderness, it is worth highlighting two additional elements that contribute to the parks' wilderness character: historic and cultural features, and scientific features.

Attributes of other features

Historic and Cultural Features:

Exploration of what is now the parks' wilderness began long before wilderness designation, the national park idea, and the arrival of Europeans in North America. This history has intrinsic wilderness value. The parks are mandated to preserve and protect cultural resources in the parks' wilderness, including prehistoric and historic habitations (Burge 2012, and National Historic Preservation Act 1966).

Ethnographic evidence suggests use by several groups of American Indians (Gayton 1948). In both prehistoric and historic times, American Indians including the Western Mono, Paiute, and Tübatulabal groups travelled through the Southern Sierra Nevada. In more recent centuries, these groups included Eastern Mono (Owens Valley Paiute) groups as well as Western Mono (possibly Wobonuch) bands in addition to Yokuts groups from the floor of the Great Central Valley and the valley's eastern foothills.

These earliest inhabitants navigated the mountain landscape, hunted and harvested, and sought the best camps. Signs of their presence in the wilderness are found in remnant camps and shelters, hunting blinds, and artifacts they left behind including arrow and spear points, bedrock mortars and mills, and lithic and ceramic scatters.

The arrival of Europeans in California brought many new explorers and settlers, including shepherds and ranchers, trappers and hunters, miners and loggers, the U.S. Army, the Civilian Conservation Corps, the Sierra Club, and other recreational travelers. These new arrivals would follow American Indian footpaths into the wilderness. Some came for economic gain, others for duty, and others for the challenge and pleasure of being in the mountains. Some, such as John Muir, also communicated their reverence for the place and were eventually successful in advocating for its preservation in its unaltered condition, which helped energize a worldwide movement to protect large tracts of wild lands. Artifacts and features from the historic period include tree carvings, cabins, trails, camps, fences, summit registers, structures on Mount Whitney and Muir Pass (Figure 25), and a resort on the Kern River.

Figure 25. The "John Muir Memorial Rest Hut," built on Muir Pass in Kings Canyon National Park by the Sierra Club in 1930. *(NPS Photo by L. Mutch)*

Historic and cultural resources serve as reminders that humans are a part of the regions' wilderness ecosystem. Interviewees described how finding historic objects like an ancient pot or spear point (Figure 26), or travelling the same routes described by historical figures such as John Muir or Norman Clyde, added to their wilderness experience.

Public comments demonstrated the value of preserving primitive skills such as packing with stock, and navigation without electronics. Modern visitors to the wilderness are part of a long history of exploration. Preserving connections to American Indians as well as early Californian culture connects people to this heritage.

Figure 26. A spear point (Humboldt Concave Base type) collected in the Siberian Outpost area of Sequoia National Park. *(NPS Photo)*

Scientific Activities: Protection of "scientific" values is one of the public purposes of wilderness, and NPS policy encourages scientific activities within wilderness, provided they are consistent with the preservation and management of wilderness (National Park Service 2006). Because of its great diversity of habitats and large biophysical gradients, the park's wilderness is a sought-after and relevant study area for understanding landscape ecology and species niches, and their probable ecological alteration as a result of climate change, and other environmental factors. This value is exemplified in multiple efforts. For example:

- Research into the relationship between fire and giant sequoias had a transformative effect on national fire policy and opened up a new area for scientific study (Bancroft et. al. 1985).
- Cave research in the parks has discovered 35 taxa new to science and contributed to a better understanding of karst systems and their importance in local hydrology (National Park Service 2011a).
- Studies of the growth patterns recorded in the rings of subalpine foxtail pines have provided insight into past climate patterns and treeline dynamics and may help inform predictions of future climate shifts (Graumlich 1993, and Lloyd 1997).
- The search to understand the factors contributing to the decline of the mountain yellow-legged frog, and ongoing restoration efforts, are still playing out in the remote sub-alpine and alpine lake basins of the two parks (Boiano and Meyer 2011, Bradford et. al. 1993, Knapp and Matthews 2000, and Knapp 2005).
- Emerald Lake and the Tokopah Valley are the best-equipped and most thoroughly researched alpine sites in the Sierra Nevada with consistent meteorological and hydrological measurements, extensive snow-sampling programs and 32 years of limnological analyses dating back to 1982. Research in this remote basin is focused on how altered climate, changing snow regime, and changes in atmospheric composition are driving biogeochemical and trophic changes in high-elevation ecosystems (Sickman et. al. 2003, and Jepsen et. al. 2012).

Threats to *other features*

Historic and Cultural Features: Reports of looting or destruction of cultural and historical sites in the parks are rare, but known. Because the terrain often dictates the location of good campsites, prehistoric and historic sites are often located near modern camp areas (Burge 2012). Using campsites that have been used by people for centuries may be a positive recreational experience and can limit impacts to natural conditions, but may also put cultural resources at risk.

Scientific Activities: The main challenge to the scientific value of the parks' wilderness may well be its conflict with other uses and values. Those research and monitoring activities that rely on developments (whether installations or motorized transport for equipment and personnel) or manipulations of natural resources may be at variance with other wilderness character qualities. Increasingly complex analyses of the wilderness character tradeoffs in conducting scientific activities may become a notable challenge to park managers and to scientists who propose to conduct projects within wilderness. The NPS will continue to make difficult choices regarding the primacy of one value over another as the needs and desires for study of the natural systems within wilderness areas grow.

Status and trends of *other features*

Historic and Cultural Features: The NPS is also required to uphold the mandates of historical and cultural resource protection laws, including: the National Historic Preservation Act; the Archeological Resources Protection Act; and the Native American Graves Protection and Repatriation Act. NPS *Management Policies* 2006 addresses cultural resource protection in wilderness by stating: "The Wilderness Act specifies that the designation of any area of the park system as wilderness "shall in no manner lower the standards evolved for the use and preservation of" such unit of the park system under the various laws applicable to that unit (16 USC 1133(a) (3)). Thus, the laws pertaining to historic preservation also remain applicable within wilderness but must generally be administered to preserve the area's wilderness character" (National Park Service 2006).

While less than 4% of the wilderness has been surveyed for cultural features, hundreds of prehistoric and historic sites have been discovered and assessed. A subset of historic structures (mostly ranger stations) are preserved and maintained by park crews while others are documented and allowed to molder.

Park managers continually explore ways to ensure that as much of the wilderness as possible is assessed for prehistoric and historic resources. For example, in 2012 archeologists accompanied soils-mapping survey teams into wilderness to ensure protection of prehistoric and historic archeological features. In advance of soil test-pit excavations, a reconnaissance survey was completed at various locations on the John Muir Trail in Kings Canyon National Park. Results of the survey included discovery of several new resource sites.

Scientific Activities**:** The scientific value of the parks' wilderness appears to be increasing, as measured by the number and quality of requests for research permits. Research projects continue to yield results applicable both to managers and to the wider scientific audience. Mitigating impacts of research on other qualities of wilderness character will continue to be an important management challenge. National Park Service policies and legal mandates support the conduct of scientific activities in wilderness, provided they are conducted in a manner consistent with wilderness preservation and are assessed through a minimum requirements analysis process (National Park Service 2006, and National Park Service Omnibus Act of 1998).

While additional data are needed on the status and trends of historic and cultural resources in wilderness, we use local knowledge to estimate the current status and anticipated trends in the other features of value (Figure 27).

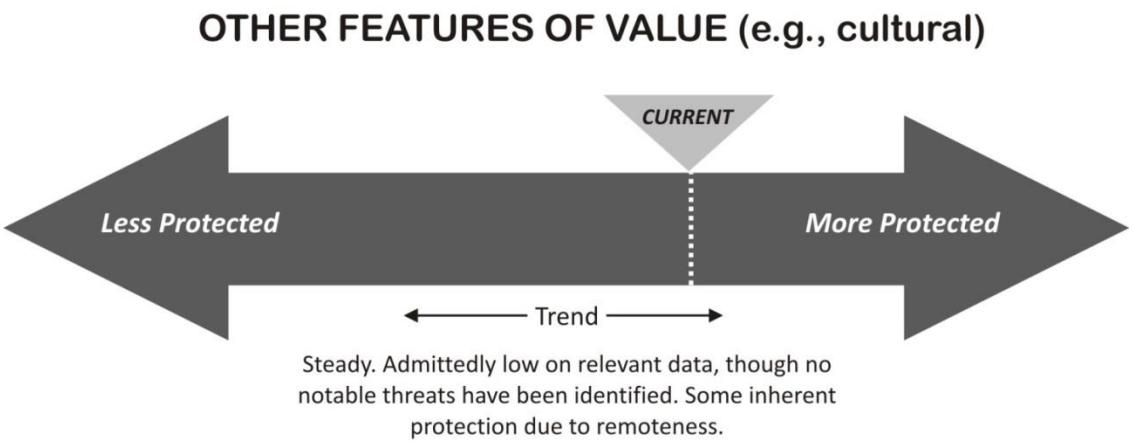

Figure 27. Graphic depicts an estimate of the current status and anticipated trends for Other Features of Value.

CONCLUSION

Sequoia and Kings Canyon National Parks protect a premier, popular, and extensive wilderness area. These wild lands have multiple distinguishing qualities and values that make them special and valuable to wilderness enthusiasts and for large-scale wild land and ecosystem preservation. These include vast tracts of undeveloped lands that are amplified by adjacent large wildernesses; great diversity of scenery and habitat ranging from foothill oak woodlands to the stark alpine environments of the highest peaks in the nation outside of Alaska; exceptional species including the world's largest and some of its longest-lived trees; spectacular examples of glacially shaped landforms; a premier recreation area where users can roam freely for scores of miles or days; and a landscape that was seminal and inspirational in the establishment of wildland preservation methods in the United States and the world.

The wilderness of these parks protects iconic scenery with waterfalls, rivers, glacier-carved canyons, and characteristic tree-scapes of sequoias, foxtail pines, and junipers. John Muir dubbed the High Sierra the "Range of Light" and the light of alpenglow or the sun's rays following a summer thundershower continues to inspire. Some interviewees called the park scenery a "stark beauty," while others described it as "sublime, the country so beautiful it's almost otherworldly."

The parks' wilderness character faces a number of threats. The most challenging to deal with, and potentially the most damaging, are those that are outside of NPS control, such as air pollution, atmospheric contaminant deposition, and climate change. As the NPS seeks to protect the *natural* quality of wilderness character, it will face difficult tradeoffs with other qualities. This will require thorough and extensive analysis of values that take into account the degree and length of management impacts to the *untrammeled* and *undeveloped* qualities and to *opportunities for solitude*. Future development of a thoughtful wilderness-character monitoring strategy will also need to identify and evaluate which developments were present and what the conditions of natural resources were (departure from fire regimes, abundance of nonnative species, etc.) at the time of wilderness designation. This will allow for more accurate descriptions of trends in wilderness character over time, allowing stewards to make informed and conscientious decisions.

While it is often practical to quantify those actions and objects that negatively impact wilderness character, measuring positive contributions to wilderness character proves more difficult. One can count numbers of helicopter landings, acres of nonnative plants, scientific installations, or numbers of wilderness users, but how does one value the contribution of the scent of sky pilot blooms, the chirp of a pika, or the thrill of ascending a mountain peak to wilderness character?

The fact that millions of people have devoted their time and effort to come and experience these parks is a strong indication that this place offers much of significance and value to humankind. The high percentage of repeat visitors signifies that they are having experiences that they value and wish to repeat or expand upon. In these parks the guidance and wisdom of the Wilderness Act has come to fruition as these parks have secured "for the American people of present and future generations the benefits of an enduring resource of wilderness."

ACKNOWLEDGMENTS

The authors wish to gratefully thank all contributors and reviewers for their valuable input, feedback, and guidance in the development of this document. These include, from outside Sequoia and Kings National Parks: Sandra Dingman (NPS – Environmental Protection Specialist, Lake Mead NRA), Alexandra Few (CA Department of Fish &Wildlife, Wildlife Biologist), Peter Landres (USFS – Aldo Leopold Wilderness Research Institute), and Suzy Stutzman (NPS – Wilderness Specialist, Intermountain Region, retired). From Sequoia and Kings Canyon National Parks staff these include: Danny Boiano (Aquatic Ecologist), Tony Caprio (Fire Ecologist), Malinee Crapsey (Interpretive Specialist), Athena Demetry (Restoration Ecologist), Annie Esperanza (Natural Resources Program Manager), Danny Gammons (Wildlife Biologist), Sylvia Haultain (Plant Ecologist), Kevin Hendricks (Chief Park Ranger), Nancy Hendricks (Environmental Protection Specialist), David Humphrey (Cultural Resource Specialist), David Karplus (Kings Canyon Trails Supervisor), Frank Klein (Cartography Technician), Linda Mutch (Assistant Wilderness Coordinator/writer/editor), Alison Steiner (Assistant Wilderness Coordinator), Charisse Sydoriak (Chief, Resource Management and Science), and Erika Williams (Visual Information Specialist).

. . . with regard to areas of wilderness, we should be guardians, not gardeners.
~ Howard Zahniser, 1963

Miter Basin, Sequoia National Park *(NPS Photo)*

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